PARTICULATE MATTER MONITORING NETWORK DESCRIPTION FOR THE BAY AREA AIR QUALITY MANAGEMENT DISTRICT PLANNING AREA

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1.0 INTRODUCTION

This is the PM2.5 monitoring plan for the **Bay Area Air Quality Management District (BAAQMD) Monitor Planning Area (MPA)**. The BAAQMD MPA encompasses approximately 15000 square kilometers with an approximate population of over 6 million. It encompasses a variety of land and water features with two large bodies of water enclosed by rugged hillside having elevations up to about 1230 meters and an eastern passage dominated by a large river basin. The coastal zones tend to be more windy and cooler in the summer that the hotter, drier interior regions with a reversal in the winter months. Precipitation is more typical of a Mediterranean climate type with dry summers and wet winters.

1.1 Physical Setting, Climate and Weather

CLIMATE, PHYSIOGRAPHY, AND AIR POLLUTION POTENTIAL -- BAY AREA AND ITS SUBREGIONS (REFERENCED BY COUNTY)

Bay Area Climate

Large-scale Influences

The summer climate of the West Coast is dominated by a semipermanent high centered over the northeastern Pacific Ocean. Because this high pressure cell is quite persistent, storms rarely affect the California coast during the summer. Thus the conditions that persist along the coast of California during summer are a northwest air flow and negligible precipitation. A thermal low pressure area from the Sonoran-Mojave Desert also causes air to flow onshore over the San Francisco Bay Area much of the summer.

The steady northwesterly flow around the eastern edge of the Pacific high pressure cell exerts a stress on the ocean surface along the west coast. This induces upwelling of cold water from below. Upwelling produces a band of cold water that is approximately 80 miles wide off San Francisco. During July the surface waters off San Francisco are 30°F cooler than those off Vancouver, more than 700 miles farther north.

Air approaching the California coast, already cool and moisture-laden from its long trajectory over the Pacific, is further cooled as it flows across this cold bank of water near the coast, thus accentuating the temperature contrast across the coastline. This cooling is often sufficient to produce condensation -- a high incidence of fog and stratus clouds along the Northern California coast in summer.

In winter, the Pacific High weakens and shifts southward, upwelling ceases, and winter storms become frequent. Almost all of the Bay Area's annual precipitation takes place in the November through April period. During the winter rainy periods, inversions are weak or nonexistent, winds are often moderate and air pollution potential is very low. During winter periods when the Pacific high becomes dominant, inversions become strong and often are surface-based; winds are light and pollution potential is high. These periods are characterized by winds that flow out of the Central Valley into the Bay Area and often include tule fog.

Topography

The San Francisco Bay Area is characterized by complex terrain consisting of coastal mountain ranges, inland valleys and bays. Elevations of 1500 feet are common in the higher terrain of this area. It can readily be seen that normal wind flow over the area would be radically distorted in the lowest levels. This is particularly true when the airmass is stable and the wind velocity is not strong. With stronger winds and unstable airmasses moving over the area this distortion is reduced. The distortion is greatest when low level inversions are present with the surface air, beneath the inversion, flowing independently of the air above the inversion. This latter condition is very common in the summer, the surface airmass being the sea breeze.

Winds

In summer, the northwest winds to the west of the Pacific coastline are drawn into the interior through the Golden Gate and over the lower portions of the San Francisco Peninsula. Immediately to the south of Mount Tamalpais, the northwesterly winds accelerate considerably and come more nearly from the west as they stream through the Golden Gate. This channeling of the flow through the Golden Gate produces a jet that sweeps eastward but widens downstream producing southwest winds at Berkeley and northwest winds at San Jose; a branch curves eastward through the Carquinez Straits and into the Central Valley. Wind speeds may be locally strong in regions where air is channeled through a narrow opening such as the Carquinez Strait, the Golden Gate, or San Bruno Gap. For example, the average wind speed at San Francisco International Airport from 3 p.m. to 4 p.m. in July is about 17 knots, compared with only about 7 knots at San Jose and less than 6 knots at the Farallon Islands.

The sea breeze between the coast and the Central Valley commences near the surface along the coast in late morning or early afternoon; it may be first observed only through the Golden Gate. Later in the day the layer deepens and intensifies while spreading inland. As the breeze intensifies and deepens it flows over the lower hills farther south along the Peninsula. This process frequently can be observed as a bank of stratus "rolling over" the coastal hills on the west side of the Bay. The depth of the sea breeze depends in large part upon the height and strength of the inversion. The generally low elevation of this stable layer of air prevents marine air from flowing over the coastal hills. It is unusual for the summer sea breeze to flow over terrain exceeding 2000 feet in elevation.

In winter, the Bay Area experiences periods of storminess and moderate-to-strong winds and periods of stagnation with very light winds. Winter stagnation episodes are characterized by outflow from the Central Valley, nighttime drainage flows in coastal valleys, week onshore flows in the afternoon and otherwise light and variable winds.

(Figure D-1 illustrates some of the most prevalent, regional wind patterns in the Bay Area; these patterns are quite general and presented without a time dimension.)

Temperature

In summer, the distribution of temperature near the surface over the Bay Area is determined in large part by the effect of differential heating between land and water surfaces. This process produces a large-scale gradient between the coast and the Central Valley as well as small-scale local gradients along the shorelines of the ocean and bays. The temperature contrast between coastal ocean water and land surfaces 15 to 20 miles inland reaches 350F or more on many summer afternoons. At night this contrast usually decreases to less than 100.

The winter mean temperature maxima and minima reverse the summer relationship in that daytime variations are small while mean minimum (nighttime) temperatures show large differences and strong gradients. The moderating effect of the ocean influences warmer minimums along the coast and penetrating the Bay. Coldest temperatures are in the sheltered valleys, implying strong radiation inversions and very limited vertical diffusion. An anomaly of warmer temperatures in the Santa Clara Valley over San Jose is clearly an urban "heat island" effect, most pronounced on winter nights. Such heat islands are proportional to structure density, and appear also over San Francisco and Oakland.

Inversions

A primary factor in air quality is the mixing depth, i.e.,the vertical dimension available for dilution of contaminant sources near the ground. Over the Bay Area the frequent occurrence of temperature inversions limits this mixing depth and consequently limits the availability of air for dilution. A temperature inversion may be described as a layer or layers of warmer air over cooler air.

Several types of temperature inversion are important. The strong inversions typical of summer are formed by subsidence, the heating of downward-moving air in the high pressure anticyclone over the western Pacific. The surface inversions typical of winter are formed by radiation as air is cooled in contact with the earth's cold surface at night. Though there is a prevalent type related to season, both inversion mechanisms may operate at any time of the year. At times, surface inversions formed by radiational cooling may reinforce the subsidence inversion aloft, particularly in fall and winter. The thick, strong inversion resulting in this case is, of course, especially effective in trapping pollutants.

The only routine measurement of the vertical temperature structure over the Bay Area is that taken by the National Weather Service twice daily, at 4 a.m. and 4 p.m. at Oakland International Airport. There is wide seasonal variation in the type of inversion found, and there is wide variation over the course of the day in inversion characteristics. Moreover, the terrain of the Bay Area may induce significant variations from point to point.

In the morning the seasonal variations are most dramatic. From June through September there are only two days per year, on average, with no inversion below 5000 feet. March and April have fewer morning inversions. The occurrence of surface inversions is highest from October through January, when the characteristic radiation inversion predominates. A wide cluster of cases between 500-2500 feet dominates from May through September, when the summer subsidence inversion over the marine layer dominates. There is substantial day-to-day variability in the depth of the marine layer.

In the afternoon data two differences from the morning data are most striking and significant. First is the frequent disappearance of the surface radiation inversion that dominates the winter nights. In these months, a surface inversion observed in the morning persists through the afternoon less than 20% of the time. However, a corresponding afternoon increase may be noted in the cases from 500 to 2500 feet. Thus the inversion is frequently raised and perhaps weakened, but not destroyed. Second is the afternoon lowering of the marine inversion that dominates the summer months. In July and August the most frequent cases are in the 500 to 1000 foot interval, compared with the 1000 to 1500 foot interval in the morning.

Precipitation

The San Francisco Bay Area climate is characterized by moderately wet winters and dry summers. Winter rains (December through March) account for about 75 percent of the average annual rainfall; about 90 percent of the annual total rainfallis received in the November-April period; and between 15 June and 22 September, normal rainfall is typically less than 1/10 inch.

Annual precipitation amounts show great differences in short distances. Annual totals exceed 40 inches in the mountains and are less than 15 inches in the sheltered or 'shadowed' valleys. The frequency of winter rain is more uniform, however, with 10 days per month (December through March) being typical.

During rainy periods, ventilation and vertical mixing are usually high, and consequently pollution levels are low. However, there are frequent winter dry periods lasting over a week. It is during some of these periods that CO and particulate pollution episodes develop.

Air Pollution Potential

The potential for the development of high pollutant concentrations in the surrounding area and at a given location depends upon the quantity of pollutants emitted in the surrounding area and the ability of the atmosphere to disperse them.

Atmospheric Pollution Potential

The combination of physiographic and climatological factors discussed above determine the condition referred to as the atmospheric pollution potential of the region. This potential might be defined quantitatively as the concentration developed in a region from a unit emission of pollutants; the term is usually used in a qualitative sense to describe the mixing power of the atmosphere. Here the atmospheric pollution potential is considered as independent of source configuration or development inside or outside the Bay Area and is a function only of physiographic and climatological features affecting atmospheric dilution. In the foregoing sense, the pollution potential is high in some Bay Area locations and low in other. Atmospheric pollution potential is in large part determined by the following four factors:

Winds:

The high frequency of low winds speeds due to the sheltering effect of surrounding terrain, and the reversal in wind direction with daytime up-valley and nighttime down-valley flow, contribute to the buildup of high concentrations of emitted pollutants. Low wind speeds limit the dilution resulting from transport away from source regions. Light winds occur most frequently during the low sun (fall, winter and early morning) and no-sun (nighttime) periods. Since a commute traffic peak occurs in the early morning and late afternoon or evening and space heating is used primarily during the winter nighttime periods with highest frequency of low speed winds, the importance of the wind speed factor becomes apparent. The other wind factor in pollution potential is the directional reversal inherent in the thermal-topographic flow regime. During periods of atmospheric stagnation when thelarge scale (synoptic) wind flow over the Bay Area is weak, local thermal-topographic flow predominates. In the sheltered valleys of the Bay Area, such a situation results in flow toward the heated western slopes by day, and drainage back toward the lower elevations by night. If stagnation is prolonged and polluted air passes back and forth across valley areas several times, the accumulation of pollutants is enhanced.

Stability

The Bay Area experiences stable atmospheric conditions common to all of coastal California. The inversion layer, which can act as a nearly impenetrable lid to the vertical mixing of pollutants, is typically based about 1500 feet above sea level and is usually due to the compressional warming of air as it sinks toward the earth's surface under the influence of a vertical circulation established in the Pacific Coast high pressure cell. When local or seasonal cooling of the earth's surface occurs as it does most frequently in fall and winter months, ground based radiation inversions form. These are particularly conducive to concentrating pollutants, such as CO from auto exhaust, emitted close to the ground. The relatively low minimum temperatures in the inland valleys of the Bay Area attest to the high frequency of radiation inversions due to surface cooling.

Solar Radiation

The high frequency of clear (no cloud) sky conditions makes many inland areas especially prone to photochemical pollution. In the presence of sunlight and warm temperatures, hydrocarbons and oxides of nitrogen react to form secondary photochemical pollutants including ozone. Inland valleys of the Bay Area are prone to the formation of photochemical pollutants if the proper chemical ingredients are provided. In late fall and winter sun angles are too low to allow significant ozone buildups. However, clear skies permit the formation of the radiation inversions associated with winter air pollution episodes, resulting in build-ups of primary pollutants such as carbon monoxide.

Sheltering Terrain

The mountain surrounding the valleys of the Bay Area are responsible directly or indirectly for much of the high pollution potential of some areas. The indirect effects have been discussed in terms of climatic features, but the hills also have a very direct effect. The horizontal dilution resulting from the meandering of wind flow currents is restricted, and concentrations are higher than they would be under flat terrain conditions. In addition, the sheltering terrain reduces the amount of exchange between the basin air and the broader scale synoptic flow, with the result that basin air is more prone than air in flat terrain to periods of stagnation.

In summary, then, the Bay Area is subject to a combination ofphysiographic and climatic factors which result in a low potential for pollutant buildups near the coast and a high potential in sheltered inland valleys. Because of the variety of meteorological factors bearing upon pollution potential, and the variety of combinations in which they can occur, it is difficult to describe pollution potential in quantitative terms. Qualitatively, however, the patterns of summer and winter pollution potential of the atmosphere probably resemble the patterns in summer-maximum and winter-minimum temperature, respectively.

In summer, areas with high average maximum temperatures tend to be sheltered inland valleys with abundant sunshine and light winds. Areas with low average maximum temperatures are exposed to the prevailing ocean breeze and experience frequent fog or stratus. Thus, locations with warm summer days have a higher pollution potential than the cooler locations along the coast and bays.

In winter, pollution potential is related to the nighttime minimum temperature. Low minimum temperature are associated with strong radiation inversions in inland valleys that are protected from the moderating influences of the ocean and bays. Conversely, coastal locations experience higher average nighttime temperatures, weaker inversions, stronger breezes and consequently less air pollution potential.

Pollution Potential Related to Emissions

The air pollution potential of a given location depends upon the emission density in the surrounding area as well as the atmospheric potential. Primary pollutant emission densities are highest in areas with high population density, heavy vehicle use or industrialization. Yet, because San Francisco has a low atmospheric pollution potential, it does not produce the highest ambient CO levels. The Bay Area's highest CO concentrations are found in San Jose, where both the atmospheric pollution potential and the emissions are high.

For secondary pollutants like ozone, which develop over periods of several hours and which are derived from two or more primary pollutants, the evaluation of the pollution potential of a location is more complex. The emission-related ozone potential at a given location depends upon precursor emissions that are upwind of (rather than adjacent to) that location on an episode day. The most direct way of evaluating the potential for exceeding the ozone standard is to review ambient monitoring data for recent years. Violations of the ozone standard are most likely to occur in an arc around the west, south and eastern sides of the Santa Clara Valley.

Subregional Background Conditions -- ClimatologicalSubregions of the Bay Area

Carquinez Strait Region

The only major sea level pass through California's Coast Range is found in the Bay Area. Here the Coast Range splits into western and eastern ranges. Between the two ranges lies the San Francisco Bay. The gap in the western coast range is known as the Golden Gate, and the gap in the eastern coast range is the Carquinez Strait. These gaps were originally cut by rivers that are part of the drainage system from the Sierra Nevadamountains runoff. Besides allowing water to flow to the ocean, these gaps allow air to pass into and out of the Central Valley.

The eastern gap, the Carquinez Strait, extends from Davis Pt in Rodeo to Martinez, ending at Suisun Bay. The term "Carquinez Strait" is often loosely used to include the region east to Antioch. At sea level, the strait is one to two kilometers wide, with terrain immediately north and south reaching 500 to 600 feet.

Prevailing winds are from the west in the Carquinez Straits, particularly during the summer. During summer and fall months, high pressure offshore, coupled with thermal low pressure in the Central Valley, caused by high inland temperatures, sets up a pressure pattern that draws marine air eastward through the Carquinez Straits almost everyday. The wind is strongest in the afternoon because that is when the pressure gradient between the East Pacific high and the thermal low is greatest. Afternoon wind speeds of 15 to 20mph are common throughout the straits region, accelerated by the venturi effect setup by the surrounding hills. Annual average wind speeds are 8.2 mph in Martinez, and 9.5 to 10 mph furthereast.

Sometimes the pressure gradient reverses and flow from the east occurs. In the summer and fall months, this can cause elevated pollutant levels in the Bay Area. Typically, for this to occur high pressure is centered over the Great Basin or the Pacific Northwest, setting up an east to west or northeast to southwest pressure gradient. These high pressure periods have low wind speeds and shallow mixing depths, thereby allowing the localized emissions to build up. Furthermore, the air mass from the east is warmer, thereby increasing photochemical activity, and contains more pollutants than the usual cool, clean marine air from the west. During the winter, easterly flow through the Strait is more common. Between storms, with the high pressure system no longer offshore, high pressure over inland areas causes easterly flow into the Bay Area through the Carquinez Strait.

Air temperatures near the Carquinez Strait do not appear to be noticeably affected by its proximity to water nor to the passage of oceanic air flows. Martinez and Antioch average daily maximum temperatures are mid to high 50's in the winter and high 80's in the summer, similar to Concord's temperatures. Average minimum temperatures are high 30's to low 40's in winter and mid-50's in summer.

Rainfall amounts in this region are variable, depending upon proximity to terrain. In flat, open areas, such as Fairfield, the annual rainfall is 22 inches. In areas where moderate-sized terrain to the west and south create a rain shadow, as in Martinez, the rainfall is 18.5 inches per year. Further east in Antioch, the annual rainfall is only 13 inches. This low amount is due to the rain shadow effects of Mt Diablo and the surrounding high terrain southwest of Antioch.

There are many industrial facilities within the Strait region that have significant emissions, i.e. chemical plants and refineries. Although, the pollution potential is usually moderated by high wind speeds, there have been infrequent upsets at the facilities that can lead to short term pollution episodes. Furthermore, because the winds in the Straits have a high persistence from the west, receptors to the east of these facilities could have a longer term exposure. Consequently, it is important that facilities maintain reasonably large buffers downwind of their sources.

Cotati and Petaluma Valleys

The valley that stretches from Santa Rosa to the San Pablo Bay is known as the Cotati Valley at the north end and the Petaluma Valley at the south end. Some maps show the whole area as the Petaluma Valley. The largest city in the Cotati Valley is Santa Rosa and in the Petaluma Valley is Petaluma. To the east, the valley is bordered by the Sonoma Mountains, with the San Pablo Bay at the southeast end of the valley. To the immediate west are a series of low hills and further west are the Estero Lowlands, which opens to the Pacific Ocean. The region from the Estero Lowlands to the San Pablo Bay is known as the Petaluma Gap. This low-terrain area is a major transport corridor allowing marine air to pass into the Bay Area.

Wind patterns in the Petaluma and Cotati Valleys are strongly influenced by the Petaluma Gap. The predominant wind pattern in this region is for marine air to move eastward through the Petaluma Gap, then to split into northward and southward paths as it moves into the Cotati and Petaluma valleys. The southward path crosses the San Pablo Bay and moves eastward through the Carquinez Straits. Consequently, although Santa Rosa and Petaluma are only 16 miles apart, their predominate wind patterns are quite different. Santa Rosa's prevailing winds are out of the south and southeast, while Petaluma's prevailing winds are out of the northwest. When the ocean breeze is weak, a bay breeze pattern can also occur, resulting in east winds near the bay. Strong winds from the east occur as part of a larger scale pattern and often carry pollutants picked up along the trajectory through the Central Valley and the Carquinez Straits. During these periods, upvalley flows can carry the polluted air as far north as Santa Rosa.

Winds are usually stronger in the Petaluma Valley than the Cotati Valley because it is part of the Petaluma Gap. The low terrain in the Petaluma Gap does not offer much resistance to the marine air as it flows to the San Pablo Bay. Consequently, even though Petaluma is 28 miles from the ocean, its climate is similar to areas closer to the coast. Average annual wind speeds at the Petaluma Airport are 7 mph. This is almost identical to the average annual wind speed measured in Valley Ford, 5 miles from the coast. Winds are light in the morning in the Petaluma Valley, and become windy in the afternoon as the sea breeze arrives. The Cotati Valley, being slightly north of the Petaluma Gap experiences lower wind speeds. In Santa Rosa, the annual average wind speed is 5.4 mph.

During summer afternoons, the fetch across the Petaluma Gap is sufficiently long so that the marine air is warmed and the fog evaporated before it reaches the Petaluma and Cotati valleys. As the surface heating weakens in the late afternoon, the marine layer becomes less heated with distance, and eventually fog is able to form in these valleys. The fog may then persist until late in the morning the next day.

Air temperatures are very similar in the two valleys. Average maximum temperatures in Santa Rosa are 1 degree higher than in Petaluma. Summer maximum temperatures for this region are in the low 80's, while winter maximum temperatures are in the high 50s to low 60s. The reverse is true for average minimum temperatures, with Petaluma being 1 degree warmer than Santa Rosa. Summer minimum temperatures are 50-51 degrees, and wintertime minimum temperatures are 36-40 degrees.

Rainfall averages are 24 inches per year at Petaluma, and 30 inches at Santa Rosa. Santa Rosa's rainfall is higher because the air is lifted and cooled in advance of the Sonoma Mountains, thereby causing condensation of the moisture. Consistent with the Bay Area Mediterranean climate, Santa Rosa receives 81% of its annual rainfall from November through March; and at Petaluma, 83% during that same period.

Generally, air pollution potential is low in the Petaluma Valley because of its link to the Petaluma Gap, and because of its low population density. However, there are two scenarios that could produce elevated pollutant levels. Stagnant conditions could occur in the morning hours with a weak ocean flow meeting a weak bay breeze flow. Another scenario can occur during the afternoon when a synoptically-induced east wind pattern advects pollution from the Central Valley to Petaluma.

The Cotati Valley lacks a gap to the sea, accommodates a larger population, and has a natural barrier at its northern and eastern ends; therefore it has a higher pollution potential than does the Petaluma Valley. During stagnant conditions, polluted air carried up the Cotati Valley by diurnal upvalley flow, and added to by local emissions, could be trapped against the mountains to the north and east.

Diablo Valley-San Ramon Valleys

In the Bay Area, the California Coast Range splits into a western and eastern range, with the San Francisco Bay between the two ranges. East of the eastern Coast Range lies the Diablo and San Ramon Valleys. The valleys have a northwest to southeast orientation. The northern portion is known as Diablo Valley and the southern portion as San Ramon Valley. The east side of the valleys are bordered by the Black Diamond Hills and Mt Diablo.

The Diablo Valley is a broad valley, approximately 5 miles wide and 10 miles long. The Carquinez Strait is at its north end; in the south, it tapers into the San Ramon Valley. Major cities in the Diablo Valley are Concord, and Walnut Creek. Martinez at the north end is better characterized by the Carquinez Strait region.

San Ramon Valley continues south from the Diablo Valley, extending from south of Walnut Creek to Dublin. The valley is long and narrow, approximately 12 miles long and one mile wide. At its southern end it opens to the Amador Valley. Its major towns are Danville and San Ramon.

The Coast Range on the west side of these valleys is 1500 to 2000 feet high. This is sufficiently high to block much of the marine air from reaching the valleys. During the daytime, there are two weakly predominant flow patterns: upvalley flow, and westerly flow across the lower elevations of the Coast Range. On clear nights, a surface inversion sets up and separates the surface flow from the upper layer flow. When this happens, the terrain channels the flow downvalley toward the Carquinez Straits. This downvalley drainage pattern can be observed all the way to Martinez at the end of the valley.

Wind speeds in these valleys rank as some of the lowest in the Bay Area. For example, in the middle of the Diablo Valley, the District station in Concord reports annual average wind speeds of 4.7 mph, and Danville in the middle of the San Ramon Valley reports annual average wind speeds of 5 mph. However, winds can pick up in the afternoon near the town of San Ramon because it is located at the eastern end of the Crow Canyon gap. Through this gap, polluted air from cities near the bay is able to travel across Hayward to the valley during the summer months.

Air temperatures are cooler in the winter and warmer in the summer because these valleys are further from the moderating effect of large water bodies, and because the Coast Range blocks marine air flow. In the Diablo Valley during the winter, Concord records daily maximum temperatures in the mid 50's. During the summer, average daily maximum temperatures are in the high 80's to 90 degrees. Average minimum temperatures in winter are in the low to mid 40's. Temperatures in the San Ramon Valley would be similar to Concord's.

These valleys rarely experience fog during the summer. In the winter, however, tule fogs are common at night. Tule fogs form on cold, clear nights when winds are light and there is abundant moisture on the ground, as happens after a rainstorm. Alternatively, the tule fog can be advected from the Central Valley through the Carquinez Strait and Livermore Valleys. These fogs usually burn off during the day, but occasionally can last for a week or two before being dissipated by the next storm.

Shielded by the Coast Range to the west, rainfall amounts in the Diablo Valley are relatively low. For example, Martinez in the north reports an annual average of 18.5 inches, while Walnut Creek reports 19 inches. Rainfall in the San Ramon Valley is expected to be similar because of the similar orientation of the terrain.

Pollution potential is relatively high in these valleys. In the winter, light winds at night, coupled with a surface-based inversion, and terrain blocking to the east and west does not allow much dispersion of pollutants. San Ramon Valley with its very narrow width, could easily have high pollution buildups from emissions contributed by the major freeway in its center, and by emissions from fireplaces and wood stoves. In the summer months, ozone can be transported into the valleys from both the Central Valley and the central Bay Area. Current levels already exceed State ozone standards.

Livermore Valley

The Livermore Valley is a sheltered inland valley within the Diablo Range near the eastern border of the District. The western side of the valley is bounded by 1000 to 1500 foot hills with two gaps connecting it to the San Francisco Bay area, the Hayward Pass at the north and Niles Canyon at the south. The eastern side of the valley also has 1000 to 1500 foot hills, the Altamont Hills, with one major passage to the San Joaquin Valley called the Altamont Pass and several secondary passages; Kellogg Creek, Patterson Pass and Corral Hollow. To the north lie the Black Hills and 3849 foot Mount Diablo. A northwest to southeast channel connects the Diablo Valley to the Livermore Valley and splits the Diablo Range into eastern and western sections. The south side of the Livermore Valley rises up to mountains of approximately 3000 to 3500 feet in the Diablo Range.

For the winter season, with the exception of an occasional storm moving through the area, air flow is often dictated by a weak pressure pattern, allowing local conditions to steer it. At night and early morning, especially on clear, calm and cold nights, gravity drives cold air downward, like water, to drain off the hills and snake through gaps and passes. During the day if some surface heating over land takes place, a thermally developed pressure field can initiate weak flow from high to low, drawing air through these same paths of least resistance which may be in the opposite direction of late night and early morning flow. On the eastern side of the valley at the Lawrence Livermore National Laboratory (LLNL), the prevailing wind direction spans the north-northeast through east-northeast sectors, caused by drainage off the hills and flow out of the Altamont Pass. Flow is light during the late night and early morning hours, about 40% of the winds are less than 3 mph. A secondary, prevailing wind direction group, east-southeast through south-southwest, accounting for about 35% of the observations, is probably associated to daytime flow through the Altamont Pass on its way to the San Joaquin Valley and associated to winter storm passages. Winter minimum temperatures average some ten degrees lower than on the coast. At the National Weather Service station maximum temperatures range from the high 50's to the low 60's while minimum temperatures are from the mid to high 30's with extremes in the high teens and low 20's. The precipitation mean is 14 inches.

By the summer the strong Pacific High has usually moved into a position to dominate Bay Area weather. Sunshine is plentiful with clear skies most of the time. Cold water upwelling along the coast and hot inland temperatures can cause a strong onshore pressure gradient which translates into a strong, afternoon wind. At the LLNL over 70% of the wind is from the south-southwest to west-southwest and by the afternoon 35% of the wind is about 11 mph. With a weak temperature inversion, air can flow over the hills with ease, but with a low and strong inversion air flow is weak, if there is any, and conforms to the twists and turns of the gaps and passes. At the National Weather Service station, maximum temperatures range from the high 80's to the low 90's with extremes in the 100's, while minimum temperatures are in the low 50's.

For the Livermore Valley the air pollution potential is high especially for photochemical pollutants. Dependent upon the meteorology for that particular summer and or fall, the frequency of elevated ozone levels at the AIR DISTRICT 's Livermore station can be significant, approaching, reaching or exceeding Santa Clara Valley levels. The valley not only traps locally generated pollutants but can be the receptor of ozone and ozone precursors from San Francisco, Alameda, Contra Costa and Santa Clara counties. This can happen near the end of an ozone episode when the sea breeze regains its strength and carries these pollutants inland. On northeasterly flow days, not uncommon in the early fall, ozone may be advected form the San Joaquin Valley to the Livermore Valley. During the winter the sheltering effect of the valley, its distance from the moderating marine air and the presence of a strong high pressure system, contribute to the development of a strong, surface based, temperature inversion. Within this stable layer local pollutants from automobiles, fireplaces and agricultural burning can concentrate, raising carbon monoxide and or particulate levels. With a growing population and no additional air quality controls, air pollution problems could become worse.

Marin County Basins

Marin County is wedge shaped, bounded on the west by the Pacific Ocean, on the east by the San Pablo Bay, on the south by the Golden Gate, and on the north by the Petaluma Gap. The county is mostly hilly. There are a few small towns on the west side, such as Stinson Beach, Bolinas, Inverness, Point Reyes Station, and Dillon Beach, but most of the population lives on the eastern side of the hills, in small, sheltered valleys. Areas along the west coast of Marin County are usually subject to cool marine air. In the summer months, the marine air is cooled as it passes over the offshore upwelling region, and forms a fog layer along the coast. In the winter, proximity to the ocean keeps the coastal regions relatively warm. Temperatures do not vary much over the year at these coastal areas: high 50s in the winter and low 60s in the summer. The warmest months are September and October, which are in the mid to high 60s.

The eastern side of Marin County has warmer weather and less fog. This is due less to the blocking effect of the hilly terrain to the west, but more to its distance from the ocean. Although there are a few mountains above 1500 feet, most of the terrain is only 800 to 1000 feet high. Much of time, this is not high enough to block the marine layer, which averages 1700 feet in depth. Because of the wedge shape of the county, area to the north are further from the ocean. This extra distance from the ocean allows the marine air mass to be heated before it arrives at eastern Marin County cities. In south Marin County, the travel distance is short, and the elevations lower, so there is a higher incidence of cool, unmodified, maritime air.

Cities next to the bay have their temperatures somewhat moderated. For example, San Rafael being near the bay, experiences average maximum winter temperatures in the high 50s to low 60s, and average maximum summer temperatures in the high 70s to low 80s. Inland areas, such as Kentfield, experience average maximum temperatures two degrees cooler in the winter and two degrees warmer in the summer. Average minimum temperatures in San Rafael are in the low 40's in winter and low 50's in summer. Minimum temperatures in Kentfield are two degrees cooler all year.

Wind speeds are highest along the west coast of Marin, about 8 to 10 mph. Although most of the terrain throughout central Marin County is not high enough to act as a barrier to the marine air flow, the complex terrain creates sufficient friction to slow the air flow. Downwind, at Hamilton AFB in east Marin County, the annual average wind speeds are only 5 mph. The prevailing wind directions throughout Marin County show less variation, and are generally from the NW.

The mountainous terrain in Marin County has higher rainfall amounts than most parts of the Bay Area (the southern Santa Cruz Mountains report higher rainfall amounts). Near Mt. Tamalpais, rainfall amounts are twice as high as the rest of the Bay Area, with San Rafael reporting an average of 37.5 inches per year and Kentfield reporting 49 inches per year. Further north, Hamilton AFB and Petaluma report 26 and 24 inches, respectively. Consistent with the Bay Area Mediterranean climate, 84% of the annual rainfall in Marin occurs November through March.

Air pollution potential is highest on the eastern side of Marin County. This is where the semi-sheltered valleys and largest population centers are located. Currently, most of the development has been along the bay, particularly in southern Marin. In the south, where distances to the ocean are short, the influence of the marine air keeps the pollution levels low. As development moves further north where the valleys are more sheltered from the sea breeze, it will encounter greater pollution potential.

Napa Valley

The Napa Valley is nestled between the Mayacamas Mountains to the west and the Vaca Mountains to the east. These mountains are effective barriers to the prevailing northwesterlies with an average ridge line height of about 2000 feet, some peaks approaching 3000 feet and 4344 foot Mount Saint Helena. The valley is 27 miles long with Napa and Calistoga defining its southern and northern ends, respectively. It is widest, 4 3/4 miles, at its southern end and narrows northward to less than a mile at Calistoga. A minor pass, Knight's Valley, links the northern end of the valley to the Alexander Valley north of Healdsburg.

An upvalley wind frequently develops during warm summer afternoons drawing from air flowing through the San Pablo Bay. During the evening, especially in the winter, downvalley drainage flow can occur. At the Bay Area Air Quality Management District's Napa station, the prevailing winds are upvalley, southwest through south southeasterly, and occur about 53% of the time. The second most common winds are down valley drainage winds, north northwesterly through northeasterly, which occur 26% of the time. Wind speeds are low with almost 50% of the winds between calm and 4 mph and an average speed of about 5 mph. Only 5 % of the winds are between 16 and 18 mph which represent strong summer time up valley winds and winter storm winds. Summer average maximum temperatures at the southern end of the valley are in the low 80's with extremes in the high 80's, and at the northern end are in the low 90's with extremes in the high 90's. Summer minima are in the low 50's. Winter maxima are in the high 50's and low 60's with minima in the high to mid-30's with the slightly cooler temperatures favoring the northern end. Winter minima extremes range from the high 20's to the mid 20's. Sunshine is plentiful and annual precipitation averages range from 43 inches at Angwin in the mountains at 1820 feet, 38 inches at Calistoga to 24 inches at Napa.

Air pollution potential is high. Summer and fall prevailing winds can transport non-local and locally generated ozone precursors northward where the valley narrows, effectively trapping and concentrating the pollutants under stable conditions. The local upslope and downslope flows setup by the surrounding mountains may also recirculate pollutants adding to the total burden. Also, the high frequency of light winds and associated stable conditions during the late fall and winter, contributes to the buildup of particulates and carbon monoxide from automobiles, agricultural burning and fireplace burning.

Northern Alameda - Western Contra Costa Counties Region

This area stretches 20 miles from the Richmond area through Oakland to San Leandro. Its western boundary is defined by the San Francisco Bay and its eastern boundary by the Oakland-Berkeley Hills. The Oakland-Berkeley Hills are a significant barrier to air flow having an approximate ridge line height of 1500 feet. The most densely populated area of the region is that strip of land between the bay and the 500 foot elevation, where most people live, drive and work. It is a narrow strip of land averaging about 4 miles in width, with a 2 mile minimum in the Berkeley and southern Richmond areas and an 8 mile maximum at points in the San Leandro and Oakland areas. This area is home to an international airport, major chemical, petroleum, shipping and other industrial operations, a large university, a major military facility (in the process of being decommissioned) and over 3/4 of a million people.

In this area, marine air intrusion through the Golden Gate, across San Francisco, and through the San Bruno Gap is a dominant weather factor throughout the year. The Oakland-Berkeley Hills causes a bifurcation of westerly flow in the vicinity of Oakland, with southerly winds observed over the San Francisco Bay north of the Golden Gate and northwesterlies over the bay to the south of the Golden Gate. The divergent wind field results in diminished speed on the east side of the bay, with a higher frequency of near calm conditions than areas west of this split flow. Temperatures have a narrow range due to the proximity of the moderating marine air. Maximum temperatures in summer average in the upper 60's to low 70's, with minimums in the mid-50's. Winter highs are in the mid to high 50's and winter lows are in the low to mid-40's. Precipitation totals, generally, increase from south to north and from the lowlands to the Oakland-Berkeley Hills' ridge line.

Alameda Naval Air Station is located on the northern end of Alameda Island, some two miles southeast of the Bay Bridge. By virtue of its closeness to the Golden Gate, it is representative of the most marine zone of the northern Alameda - western Contra Costa region. The prevailing wind direction is westerly with a 57% frequency for wind within the northwest-southwest sector. The average speed for this sector is 9 mph and ranges from 7 to 10 mph.

Winds less than 5 mph occur 30% of the time. Maximum temperatures in summer average only in the upper 60's, with minimum in the mid-50's. Winter highs are in the mid-50's and winter lows in the mid-40's. Sunshine is somewhat more scarce than at more inland stations. Precipitation averages about 20 inches per year.

The Oakland Airport is 10 miles southeast of the Bay Bridge. The wind regime is very similar to that at Alameda as might be expected from their close proximity. A bay-breeze effect along the immediate shoreline, probably augmented by a low profile in the hills to the east, gives rise to a prevailing wind from the west. Almost 50% of the wind is from the northwest-southwest sector. The average wind speed for this northwest through southwest sector is 9 mph and ranges from 6 to 11 mph. Observations of less than 7 mph occurs 50% of the time. A secondary frequency maximum from a southeasterly direction may reflect drainage of air through the nearby Hayward Gap, particularly in winter, but with lower speeds than for the westerly direction. When compared to Alameda, summer maximum and winter minimum temperatures are slightly higher and lower, respectively, as would be expected of a station slightly further away from the moderating effect of marine air. Maximum summer temperatures average near 70 degrees F and minima average in the low 50's. In winter maximums are in the middle 50's and minimums are in the upper 30's. Precipitation totals near 18 inches annually, on the average. Sunshine is slightly more plentiful than at the more coastward locations, but invasions of stratus in summer keep the amount somewhat lower than at the more inland locations.

Berkeley is built along the eastern edge of the San Francisco Bay and up the Berkeley Hills, ten miles east of the Golden Gate Bridge and two miles north of the Bay Bridge. Maximum temperatures in summer average about 70 degrees with minimums in the mid-50's. Winter highs are in the high-50's to low 60's and winter lows are in the mid-40's. Annual precipitation averages 23 inches.

Richmond, the northern most city of this zone, is ten miles northeast of the Golden Gate. At the AIR DISTRICT 's Point San Pablo meteorological station, 4 1/2 miles west northwest of downtown Richmond, the prevailing direction is south southwesterly with over 50% of the winds coming from the south through southwest sector. The average wind speed at this station is 11 mph. Richmond's maximum summertemperatures average in the low 70's and minimums average in the mid-50's. In winter maximums are in the high 50's to low 60's and minimum are in the low to mid-40's. Precipitation totals near 22 inches annually, on the average.

The air pollution potential of the areas closest to the marine air is minor, due to frequent good ventilation and less influx of high pollutant concentrations from upwind sources. Occurrence of light winds, however, mainly during the night and early morning, may set the scene for occasional elevated pollutant levels. The air pollution potential south and north of this region is higher and might be termed marginal. Its location, downwind and surrounded by air pollution sources, coupled with a relatively high frequency of light winds, mainly in the nighttime and early morning hours, could augment higher pollutant levels.

Peninsula

The peninsula region of the Bay Area extends from the area northwest of San Jose to the Golden Gate. The Santa Cruz Mountains extend up the center of the peninsula, with elevations exceeding 2000 feet at the south end, and gradually decreasing to 500 feet elevation in South San Francisco, where it terminates. On the west side of the mountains lie small coastal towns, such as Half Moon Bay and Pacifica, that due to coastal ocean upwelling and northwest winds, experience a high incidence of cool, foggy weather in the summer. On theeast side of the mountain range lie the larger cities. Cities in the southeastern peninsula experience warmer temperatures and few foggy days, because the marine layer, with an average depth of 1700 feet, is blocked by the 2000 foot ridge to the west. At the north end of the peninsula lies San Francisco. Because most of topography of San Francisco is below 200 feet, the marine layer is able to flow across most of the city, making its climate cool and windy.

The blocking effect of the Santa Cruz Mountains can be seen in the summertime maximum temperatures. For example, at Half Moon Bay and San Francisco, the maximum daily temperatures in June through August are 62 to 64 degrees F, while on the eastern side at Redwood City, the maximum temperatures are in the low 80s for the same period. Daily maximum temperatures throughout the peninsula during the winter months are in the high 50s. Large temperature gradients are not seen in the minimum temperatures. Average minimum temperatures at Half Moon Bay are about 43 degrees inwinter, and 50-52 in summer. The east peninsula, represented by Redwood City, reports winter minimum temperatures of 40 degrees, and summer minimum temperatures of 52-54 degrees.

Annual average wind speeds range from 5 to 10mph throughout the peninsula. The tendency is for the higher wind speeds to be found along the western coast. However, winds on the east side of the peninsula can also be high in certain areas because low-lying areas in the mountain range, at San Bruno Gap and Crystal Springs Gap, commonly allow the marine layer to pass across the peninsula.

The prevailing winds are westerly along the peninsula'swest coast. Individual sites can show significant differences, however. For example, Ft Funston in western San Francisco County, shows a southwest wind pattern, while Pillar Point in San Mateo County to the south shows a northwest wind pattern. Sites on theeast side of the mountains also show a westerly pattern, although their wind patterns show influence by local topographic features. That is, a few hundred feet rise in elevation will induce flow around that feature instead of over it during stable atmospheric conditions. This can change the wind pattern by as much as 90 degrees over short distances. On mornings without a strong pressure gradient, areas on theeast side of the peninsula often experience eastern flow in the surface layer, induced byupslope flow on the east-facing slopes and by the bay breeze. The bay breeze is rarely seen after noon because the stronger sea breeze dominates the flow pattern.

On the peninsula, there are two important gaps in the Coast Range. The larger of the two is the San Bruno Gap, extending from Ft Funston on the ocean side to the San Francisco Airport on the bay side. Because the gap is oriented in the same northwest to southeast direction as the prevailing winds, and because the elevations along the gap areunder 200 feet, marine air is easily able to penetrate into the bay.

The other gap in the Santa Cruz Mountains is the Crystal Springs Gap, along the highway 92 route between Half Moon Bay and San Carlos. The low point is 900 feet, with elevations of 1500 feet north and south of the gap. As the sea breeze strengthens on summer afternoons, the gap permits maritime air to pass across the mountains and its cooling effect is commonly seen from San Mateo to Redwood City.

Rainfall amounts on the east side of the peninsula are somewhat lower than on the west side with San Francisco and Redwood City reporting an average of 19.5 inches per year. On the west side, Half Moon Bay reports 25 inches per year. Areas in the Santa Cruz Mountains are significantly higher, especially west of the ridge line, due to orographic-lifting induced condensation, close proximity to a moisture source, and fog drip.

Air pollution potential is highest along the southeastern portion of the peninsula because this area is most protected from the high winds and fog of the marine layer, the emission density is relatively high, and pollutant transport from upwind sites is possible. In San Francisco, to the north, pollutant emissions are high, but winds are generally fast enough to carry the pollutants away before they can accumulate.

Santa Clara Valley

The northwest-southeast oriented Santa Clara Valley is bounded by the Santa Cruz Mountains to the west, the Diablo Range to the east, the San Francisco Bay to the north and the convergence of the Gabilan Range and the Diablo Range to the south. Temperatures are warm in summer, under mostly clear skies, although a relatively large diurnal range results in cool nights. Winter temperatures are mild, except for very cool but generally frostless mornings. At the northern end of the Santa Clara Valley, the San Jose Airport mean maximum temperatures range from the high 70's to the low 80's during the summer to the high 50's-low 60's during the winter, and mean minimum temperatures range from the high 50's during the summer to the low 40's during the winter. Further inland where the moderating effect of the Bay is not as strong, temperature extremes are greater. For example, the AIR DISTRICT 's San Martin station, located 27 miles up the Santa Clara Valley from the San Jose Airport, can be greater than 10 degrees Fahrenheit warmer on hot summer afternoons and greater than 10 degrees cooler during cold winter nights. Rainfall amounts are modest ranging from 13 inches in the lowlands to 20 inches in the hills.

The wind patterns in the Valley are influenced greatly by the terrain, resulting in a prevailing flow roughly parallel to the Valley's northwest-southeast axis with a north-northwesterly sea breeze extending up the valley during the afternoon and early evening and a light south-southeasterly drainage flow occurring during the late evening and early morning. In summer a convergence zone is sometimes observed in the southern end of the Valley between Gilroy and Morgan Hill, when air flowing from the Monterey Bay through the Pajaro Gap gets channeled northward into the south end of the Santa Clara Valley and meets with the prevailing north-northwesterlies. Speeds are greatest in the spring and summer, and least in the fall and winter. seasons. Nighttime and early morning hours have light winds and are frequently calm in all seasons, while summer afternoon and evenings are quite breezy. Strong winds are rare, coming only with an occasional winter storm.

The air pollution potential of the Santa Clara Valley is high. The valley has a large population and the largest complex of mobile sources in the Bay Area making it a major source of carbon monoxide, particulate and photochemical air pollution. In addition, photochemical precursors from San Francisco, San Mateo and Alameda counties can be carried along by the prevailing winds to the Santa Clara Valley making it also a major ozone receptor. Geographically, the valley tends to channel pollutants to the southeast with its northwest/southeast orientation, and concentrate pollutants by its narrowing to the southeast. Meteorologically, on high-ozone low-inversion summer days, the pollutants can be recirculated by the prevailing northwesterlies in the afternoon and the light drainage flow in the late evening and early morning, increasing the impact of emissions significantly. On high particulate and carbon monoxide days during late fall and winter, clear, calm and cold conditions associated with a strong surface based temperature inversion prevail.

Sonoma Valley

The Sonoma Valley lies to the west of and parallels the Napa Valley. It is separated from the Napa Valley by the Mayacamas Mountains and from the Cotati and Petaluma Valleys by the Sonoma Mountains. The Sonoma Mountains are not as high nor as extensive as the Mayacamas. The valley is 22 miles long and narrow. The valley floor is no more than 5 miles wide at its southern end, and quickly shrinks to 2 miles and then less than a mile wide further north.

The climate is like Napa's. Even though no long term wind measurements are known to exist in the valley, available information suggests that the valley has the same basic wind characteristics as other valleys; strongest up valley winds in the afternoon during the summer, and best down valley winds during clear, calm cold winter nights. Prevailing winds would follow the longitudinal axis of the valley, northwest/southeast, while some upslope flow during the day and downslope flow during the night may be observed near the base of the mountains. At the town of Sonoma summer average maximum temperatures are in the high 80's reaching 90 degrees in July with extremes in the mid 90's. Summer minimum are 49 to 50 degrees F. Winter maximum are in the high 50's to the mid 60's with minimum ranging from the mid 30's to 40 degrees F. Winter minimum extremes range from the high 20's to the low 30's. Sunshine is plentiful and annual precipitation averages 29 inches.

As in the Napa Valley, air pollution potential is high. Prevailing winds can transport non-local and locally generated ozone precursors northward into the narrow valley which can effectively trap and concentrate the pollutants under stable conditions. The local upslope and downslope flows set up by the surrounding mountains may also recirculate pollutants adding to the total burden. Also, with light to calm winds and associated stable conditions during the late fall and winter, particulates and carbon monoxide concentrations from automobiles, agricultural burning and fireplace burning can become elevated.

Southwestern Alameda County

This region encompasses the low-lying area on the southeast side of the San Francisco Bay, from south of Hwy 580/Dublin Canyon to north of Milpitas. The region is bordered on the east by the 1600 foot East Bay Hills, and on the west by the Bay. Most of the area is very flat. The cities in this region are San Lorenzo, Hayward, Union City, Newark, and Fremont.

Situated between the western and eastern portions of the Coast Range, this region is protected from the direct effects of the marine air flow. Marine air entering through the Golden Gate is forced to diverge into northerly and southerly paths because of the blocking effect of the east bay hills. The southern flow is directed southeasterly down the bay, parallel to the hills, where eventually it passes over southwestern Alameda County. These sea breezes are strongest in the afternoon. The further from the ocean the marine air travels, the more it is modified. Thus, although the climate in this region is affected by sea breezes, it is affected less so than the regions closer to the Golden Gate, to the north.

The climate of southwestern Alameda County is also modified by its close proximity to the San Francisco Bay. Evaporation from the bay will cool the air in contact with it during warm weather, while during cold weather, the bay can act as a heat source. The normal northwest wind pattern will then carry this air onshore. During periods of flat pressure gradients, the bay can generate its own circulation system. This bay breeze, similar to the sea breeze, pushes cool air onshore during the daytime and draws air from the land offshore at night. Bay breezes are common in the morning, before the sea breeze begins.

Winds are predominantly out of the northwest quadrant in this region, particularly during summer months. In the winter, winds are equally likely out of the east. Cold air over land areas creates high pressure to the east, which forces air toward the west. Easterly surface flow into southern Alameda County passes through three major gaps: Hayward/Dublin Canyon, Niles Canyon, and Mission Pass. Areas north of the gaps then experience southeast winds, while areas south of the gaps experience northeast winds. Wind speeds are moderate in this region. Annual average wind speeds close to the bay are about 7 mph, while further inland at Fremont they are 6 mph.

Air temperatures are moderated by both the proximity to the bay and to the sea breeze. Temperatures in this region are slightly cooler in the winter and slightly warmer than east bay cities to the north. Average daily maximum temperatures in winter at Newark are in the high 50's to 60 degrees. During the summer months, average daily maximum temperatures are in the mid 60's. Average minimum temperatures are in the low 40's in winter and mid 50's in the summer

Rainfall amounts in the region are lower than other east Bay sites to its north. Areas near the bay, such as Newark have lower rainfall amounts because of the rain shadow effect of the Santa Cruz Mountains. Newark annual rainfall is 14 inches. Areas closer to the hills have higher rainfall amounts because they are further from the Santa Cruz Mountains and because of orographic effects. That is, air that is forced to ascend the mountains will cool and condense, leading to increased rain.

Pollution potential is relatively high in this region during summer and fall months. When high pressure dominates the weather, low mixing depths and bay and ocean wind patterns can concentrate and carry pollutants from other cities to this area, adding to the locally emitted pollutants. The polluted air is then pushed up against the East Bay Hills. Flow eastward through the gaps is weak because winds in the Livermore Valley are usually from the east. Wintertime pollution levels are only moderate.

County - Subregional References

County References To Air Basin Subregions (climatic subregions), described above

ALAMEDA COUNTY
see: Diablo Valley-San Ramon Valleys; Livermore Valley; Northern Alameda-Western Contra Costa Region; Southwestern Alameda County

CONTRA COSTA COUNTY
see: Carquinez Strait Region; Diablo Valley-San Ramon Valleys; Northern Alameda-Western Contra Costa Region;

MARIN COUNTY
see: Marin County Basins

NAPA COUNTY
see: Napa Valley

SAN FRANCISCO COUNTY
see: Peninsula

SAN MATEO COUNTY
see: Peninsula
SANTA CLARA COUNTY
see: Santa Clara Valley; Peninsula (southern end)

SOLANO COUNTY
see: Carquinez Strait Region

SONOMA COUNTY
see: Sonoma Valley; Cotati and Petaluma Valley

Figure D1: Bay Area Air Basin Climatological Subregions

1.2 Population Characteristics

The Bay Area Population by County and major cities is shown in Tables 1.2.1and 1.2.2. In Table 1.2.1, note that only the BAAQMD portion of Solano and Sonoma Counties are included. In Table 1.2.2, the major cities and their populations are shown in conjunction with the selected monitoring site that will represent them. Map 1.2a shows the boundaries of the BAAQMD MPA and the Planning Metropolitan Statistical Areas (PMSA) that it represents.

Table 1.2.1
1992 Bay Area Population by County

County	Population
Alameda	1,306,309
Contra Costa	836,430
Marin	235,210
San Francisco	729,330
San Mateo	662,790
Santa Clara	1,534,046
Napa	113,330
Solano – D*	272,930
Sonoma – D*	350,841
TOTAL	**6,043,249**

*D = BAAQMD portion of the county.
Source: ABAG population reports 1993

Table 1.2.2 Bay Area 1996 City Populations (> 10,000) and Associated PM2.5 Sites

Concord	2-	Population
Concord	111,800	
Antioch	76,500	
Walnut Creek	62,200	
Pittsburg	50,800	
Martinez	35,350	
Pleasant Hill	31,450	
Lafayette	23,600	
Orinda	16,900	
Moraga	16,350	
Brentwood	14,500	
Clayton	10,050	

Redwood City	Population
San Mateo	92,200
Redwood City	73,200
Palo Alto	59,900
San Bruno	40,800
Menlo Park	30,550
Foster City	29,750
Burlingame	28,550
San Carlos	28,050
Los Altos	28,000
Belmont	25,200
East Palo Alto	25,050
Millbrae	21,450
Hillsborough	11,350

Livermore	Population
Livermore	67,800
Pleasanton	59,800
San Ramon	41,950
Danville	38,100
Dublin	26,750

Santa Rosa - 5th Street	Population
Santa Rosa	127,700
Petaluma	49,000
Novato	46,100
Rohnert Park	38,700

San Francisco - Arkansas St.	Population
San Francisco	778,100
Daly City	101,300
South San Francisco	57,600
San Rafael	53,400
Pacifica	39,650
Mill Valley	13,900
San Anselmo	12,300
Larkspur	11,750
Half Moon Bay	10,850

Fremont	Population
Fremont	192,200
Hayward	123,900
Alameda	76,300
San Leandro	72,600
Union City	59,700
Newark	40,450

Vallejo	Population
Oakland	388,100
Vallejo	110,500
Berkeley	105,900
Richmond	91,300
Fairfield	89,000
Napa	68,000
Benicia	27,350
San Pablo	25,900
Suisun City	25,800
El Cerrito	23,300
Hercules	18,800
Pinole	18,150
Albany	17,300
Piedmont	11,300

San Jose - 4th St & San Jose - Tully Rd	Population
San Jose	873,300
Sunnyvale	129,300
Santa Clara	100,000
Mountain View	73,000
Milpitas	61,200
Cupertino	44,800
Campbell	39,300
Gilroy	35,250
Saratoga	30,600
Los Gatos	29,700
Morgan Hill	29,250
Gilroy	35,250
Saratoga	30,600
Los Gatos	29,700
Morgan Hill	29,250

MAP 1.2a

1.3 Climate and Weather (See section 1.1)

1.4 Dominant Economic Activities and Emission Sources

The Bay Area economy is dominated by a few large industries, many smaller industries and a large number of services oriented companies. Residential zones and their related support and activity centers are interspersed with the larger business zones.

Table 1.4 lists the major activities that surround or are in reasonable proximity of the selected PM2.5 monitoring stations. Each economic activity in the area of these PM2.5 monitors is the direct and/or indirect cause of specific air pollutant emissions. The petrochemical industries, primarily refineries and related chemical operations, are a significant economic activity in the southeast portion of San Pablo Bay, the Carquinez Strait, Suisun Bay and the Sacramento Delta. Another major economic activity in the Bay Area is the electronics industry which has its largest concentration in the Silicon Valley which occupies Southern Alameda County, Southern San Mateo County, and the Northern Santa Clara Valley. Also, major traffic arteries, with their associated traffic congestion, pass through and around the many commercial and residential centers that ring the bays and hills of the District and are major sources of air pollution in the Bay Area.

Table 1.4 Dominant Economic Activities and Emission Sources

PM2.5 Monitoring Station	AIRS Site ID	Dominant Economic Activities and Emission Sources
Fremont - Chapel Way	06 001 1001	Residential, commercial, highway
Livermore - Old First St.	06 001 0003	Residential, commercial, open space, highway
Concord - 2975 Treat Blvd.	06 013 0002	Residential, commercial, undeveloped, highway, Petrochemical Industry
San Francisco - Arkansas St.	06 075 0005	Industrial, residential, highway
Redwood City	06 081 1001	Industrial, commercial, residential, highway
San Jose - 4th St. (Downtown)	06 085 0004	Residential, commercial, industrial-electronics, university, highway, airport
San Jose - Tully Rd.	06 085 2003	Commercial, residential, industrial, county fairgrounds, highway
Vallejo - 304 Tuolumne	06 095 0004	Commercial, residential, Petrochemical Industry
Santa Rosa - 897-5th St.	06 097 0003	Commercial, residential, suburban, industrial

1.5 PM2.5 Monitoring Requirements

The PM2.5 monitoring requirements are based on population. Population data for the BAAQMD is shown in Table 1.2.1: 1992 Bay Area Population by County, and Table 1.2.2: Bay Area 1996 City Populations (>10,000) and Associated PM2.5 Sites. Map 1.2a shows the BAAQMD's monitoring planning area, its five Planning Metropolitan Statistical Areas (PMSA) and the required number of core PM2.5 monitors for each PMSA based on population. The major PMSAs are: (1) San Francisco in the West Bay Area covering Marin, San Francisco and San Mateo Counties; (2) Oakland in the East Bay covering Contra Costa and Alameda Counties; and (3) Santa Clara in the South Bay covering Santa Clara County. The North counties of Solano, Napa and Sonoma are less densely populated and are included in the Santa Rosa PMSA and in the Napa-Vallejo-Fairfield PMSA. The BAAQMD is required to have a total of 12 core monitors: the Oakland PMSA requires 4 core monitors, the Santa Clara and San Francisco PMSAs each require 3 core monitors and the Santa Rosa and Napa-Vallejo-Fairfield PMSAs each require 1 core monitor.

The original requirement for the Bay Area was 12 PM2.5 sites. However, one or more required core SLAMS may be exempted in an area where the highest concentrations is expected to occur at the same location as the area of maximum population impact; and one or more required core SLAMS may be exempted in an area with low concentrations (e.g., highest concentrations are less that 80 percent of the NAAQS). We propose one less monitor in the San Francisco PMSA, one less monitor in the San Jose PMSA and one less monitor in the Oakland PMSA (see Maps 1.2a and 2.1a in section 2.1). The remaining nine sites would adequately cover the Bay Area. We support our proposal with data collected by current PM2.5 and PM10 sampling.

The Bay Area has been fortunate to have a Dichot sampler operating at its San Jose Fourth Street station since 1990. Since a Dichot sampler is a non FRM instrument, the data cannot be directly related to PM2.5 standards but it can be used as an indicator of PM2.5. The San Jose Fourth Street station has consistently experienced some of the highest PM10 in the Bay Area and is believed to have some of the highest PM2.5 in the Bay Area. Table 1.5.1 shows the results of nearly eight years of sampling PM2.5 from a Dichot sampler.

The Dichot data suggest that PM2.5 will probably not be over the daily or the annual standards. Monitoring will need to be done to prove attainment, but it is very likely that the 9 sites selected for sampling will be more than adequate to define the Bay Area's attainment status. Table 1.5.2 shows the highest and second highest PM10 24-hour values for the past six years. Table 1.5.3 shows the PM10 Annual Averages for the past nine years. The Bay Area's relatively low Dichot PM2.5 and PM10 concentrations summarized in these two tables indicate that PM2.5 particulate should not need a larger sampling network than the nine sites planned for activation in 1998.

Table 1.5.1 San Jose Fourth Street Dichot Sampling for PM2.5 in $\mu g/m^3$

Year	24-hour highest value	Annual Arithmetic Average
1990	105	18.3
1991	86	16.7
1992	59	13.8
1993	60	12.9
1994	55	12.6
1995	36	10.3
1996	40	9.5
1997	44*	

- Through May 1997

Table 1.5.2 PM 10 Highest and Second Highest 24-Hour Concentrations in $\mu g/m^3$ by Station and Year

STATION	**1992 High / 2ND High**	**1993 High / 2ND High**	**1994 High / 2ND High**	**1995 High / 2ND High**	**1996 High / 2ND High**	**1997 High / 2ND High**
SAN FRANCISCO	81 / 69	69 / 64	94 / 65	50 / 48	71 / 59	81 / 65
SAN RAFAEL	63 / 58	69 / 45	72 / 72	74 / 48	50 / 47	72 / 60
RICHMOND / SAN PABLO	55 / 53	76 / 60	83 / 67	54 / 42	43 / 42	78 / 48
NAPA	74 / 73	70 / 63	86 / 53	69 / 46	57 / 39	78 / 71
CONCORD	73 / 71	81 / 68	87 / 78	56 / 49	72 / 41	76 / 55
BETHEL ISLAND	73 / 73	71 / 70	65 / 64	73 / 72	76 / 45	77 / 71
SAN LEANDRO	56 / 51	51 / 47	62 / 49	47 / 42	59 / 44	65 / 30
FREMONT	92 / 60	77 / 67	82 / 73	51 / 50	59 / 41	63 / 44
LIVERMORE	99 / 62	84 / 71	97 / 75	52 / 49	71 / 41	62 / 55
SAN JOSE-4TH	106 / 98	92 / 91	93 / 86	60 / 59	76 /68	78 / 69
SAN JOSE EAST					59 / 51	55 / 39
SAN JOSE- MOORPARK	104 / 84	76 / 72	67 / 67	55 / 40	58 / 48	61 / 53
SAN JOSE-TULLY	110 / 100	101 / 94	90 / 89	49 / 48	67 / 34	95 / 72
SANTA ROSA				46 / 46	38 / 35	85 / 55
VALLEJO				59 / 49	49 /38	85 / 63
REDWOOD CITY	80 / 75	76 / 72	76 / 65	48 / 42	48 /45	70 / 65

Table 1.5.3 BAAQMD PM_{10} ($\mu g/m^3$) Annual Arithmetic Averages 1989 -1997

Station	1989	1990	1991	1992	1993	1994	1995	1996	1997
San Francisco	36.0	34.0	34.9	31.6	29.0	28.0	24.9	24.3	22.5
San Rafael	29.9	26.0	30.4	24.5	23.4	24.1	20.9	21.8	20.3
Richmond	30.7*	26.5	29.1	26.1*	25.4	24.8	21.6	20.4	**
Napa	32.0	34.1	33.0	27.0	24.9	23.3	20.3	19.9	16.6
Concord	30.5	27.1*	31.2	26.0	22.8	23.8	19.7	18.0	17.5
Bethel Island	29.0	29.5	33.4	26.1	23.6	23.0	23.3	21.1	19.9
San Leandro			32.4	24.9	20.8	21.1	19.5	21.0	15.9
Fremont	32.6*	32.4	33.7	26.3	25.6	24.9	21.9	22.7	21.8
Livermore	37.4	32.7	36.5	29.0	24.3	25.4	22.4	22.1	22.0
San Jose-4th	41.2	33.6	33.0	33.3	31.6	30.4	25.8	24.8	23.7
San Jose-West	40.6*	33.3	37.9	34.0	28.1	28.3	**	**	**
San Jose-	38.0	35.4	36.4	28.3	23.0	23.4	19.0	20.0	18.4
San Jose-Tully		40.2	34.5	31.8	27.9	26.9	22.9	20.0	21.3
San Jose -							*	21.3	19.3
Redwood City	33.3	28.2	32.1	28.7	26.5	24.9	21.0	21.0	22.3
Santa Rosa						17.8*	15.5	17.0	16.5
Vallejo						26.2*	18.7	17.3	15.6

*** Incomplete data set - Station began in mid-year. ** Station closed National Standard: 50µg/m^3**

Note: Data from CARB's California Air Quality Data publications for 1989 to 1992; 1993 through 1997 data from BAAQMD's Contaminant and Weather Summary.

2.0 PM2.5 MONITORING NETWORK ELEMENTS

Several types of PM2.5 monitors will be part of the PM2.5 monitoring network. This section summarizes the PM2.5 monitors: (1) planned for deployment in 1998 and 1999; and (2) existing PM2.5 particulate matter monitors. For a summary of particulate matter monitoring outside of the BAAQMD PM2.5 monitoring network, please refer to the statewide summary.

2.1 PM2.5 Monitors Planned for Deployment

To satisfy monitoring objectives of the PM2.5 program several types of PM2.5 monitors will be needed. The most important objective of the PM2.5 monitoring program is to develop a data base for comparison to the annual-average and 24-hour-average PM2.5 National Ambient Air Quality Standards. The Federal Reference Method (FRM) monitors will collect mass measurements to support attainment or non-attainment area designations. Other monitoring instruments including continuous analyzers and speciation samplers will provide temporally resolved data and some chemical characterization of PM2.5 data.

Table 2.1.1 summarizes the locations planned for deployment in 1998 with first full calendar year of operation in 1999. Map 2.1a shows the locations of these monitors. Once the PM2.5 monitors are operating successfully at Livermore and Concord the existing Dichot samplers at these stations will be removed. The existing Partisol sampler at San Jose Fourth Street will be used to test PM2.5 at non-network sites.

Table 2.1.1 PM2.5 Monitoring Network

Site Location	AIRS Site ID	PM2.5 FRM	PM2.5 Speciation	PM2.5 TEOM/BAM	Other PM2.5 Monitors (Specify)
Fremont - Chapel Way	06 001 1001	X			
Livermore - Old First St.	06 001 0003	X	Y		Dichot
Concord - 2975 Treat Blvd.	06 013 0002	X	Y		Dichot
San Francisco - Arkansas St.	06 075 0005	XX	Y		
Redwood City	06 081 1001	X			
San Jose - 4th St.	06 085 0004	XX	Y		Dichot; Partisol
San Jose - Tully Rd.	06 085 2003	X			
Vallejo - 304 Tuolumne	06 095 0004	X			
Santa Rosa - 837-5th St.	06 097 0003	X			

Codes:

X - Monitor to be deployed in 1998
Y - Monitor to be deployed in 1999
XX - Collocated particulate monitors used for precision data to be deployed in 1998
YY - Collocated particulate monitors used for precision data to be deployed in 1999

MAP 2.1a

MAP 2.2a

2.2 Existing Particulate Matter Monitoring

PM10 instruments are located at all of the PM2.5 sites as shown in Table 2.2.1. Map 2.2a shows the entire PM10 network and the currentDichot sites. In addition, TEOM instruments are located at two stations, Livermore and San Jose - Fourth Street. Finally, five sites have COH monitoring for both forecasting and analysis. For a statewide summary of particulate matter monitoring outside of the BAAQMD PM2.5 network, please refer to the statewide summary in the California PM2.5 Monitoring Plan.

Table 2.2.1
Existing Particulate Matter Monitors to be collocated with PM2.5 Monitors

Site Location*	AIRS Site ID	Dichot	PM10 SSI	PM10 TEOM/BAM	Other Particulate Matter Monitors (Specify)
Fremont - Chapel Way	06 001 1001		X		COH
Livermore - Old First St.	06 001 0003	X	XX	X	
Concord - 2975 Treat Blvd.	06 013 0002	X	X		COH
San Francisco - Arkansas St.	06 075 0005		X		COH, TSP
Redwood City	06 081 1001		X		COH
San Jose - 4th St.	06 085 0004	X	XX	X	COH, TSP
San Jose - Tully Rd.	06 085 2003		X		
Vallejo - 304 Tuolumne	06 095 0004		X		
Santa Rosa - 837-5th St.	06 097 0003		X		COH

Codes:
- X - Existing monitor
- XX - Collocated PM10 monitor with PM10 monitor used for precision assessment
- COH - AISI Tape Sampler for SoilingIndex (Coefficient of Haze)

2.3 PM2.5 Quality Assurance

At this time, the BAAQMD plans to adopt the California Air Resources Board (CARB) Schedule that will be developed by their Quality Assurance/Quality Control Branch. Please see the statewide summary for the schedule.

2.4 Laboratory Analyses

The BAAQMD will weigh its own filters. The current laboratory requires the installation of self-contained environmental controls, an entry that will minimize air exchange between the weighing laboratory and the outside, the purchase of an approved micro-balance and its installation on a vibration reducing platform, and some modifications to the laboratory space itself. We plan to have the work finished no later than 1 September 1998. However, we are not equipped to perform speciation analyses.

3.0 PM2.5 MONITORING SITES TO BE DEPLOYED IN 1998

We are planning to deploy eleven PM2.5 instruments at nine sites in 1998; two sites will have collocated monitoring for precision checks. This section defines why these sites were selected to monitor for PM2.5. The selected sites along with the more important parameters that characterize each site are listed in the appropriate sub-section below.

3.1 Monitoring Sites

The PM2.5 monitoring sites were selected based upon the guidelines set forth in this new standard, namely to have enough instruments to accurately define the PM2.5 characteristics of the Bay Area and find the areas where the highest concentrations may impact a substantial number of Bay Area residents. In section 1.1, we examined the diverse climatology and topography of the Bay Area to determine how PM2.5 might be distributed. In section 1.2, and especially Table 1.2.2, the population distribution was examined with respect to the proposed PM2.5 sites to determine representativeness of the sites with a small, but adequate, network of samplers. In Tables 1.5.1, 1.5.2 and 1.5.3 the District's PM10 and PM2.5 experiences were summarized and this data were used to assure that the proposed PM2.5 sites would measure representative concentrations.

The suspected area source emission hot spots include wood smoke areas. In the Bay Area any densely populated residential area, especially those in sheltered valleys, are more likely to experience elevated PM2.5 concentrations due wood smoke.

The existing particulate matter network was based upon the design criteria defined in the previous particulate standards. All proposed PM2.5 sites are at current PM10 sites. The existing network, as shown in Table 2.2.1 and Map 2.2a, consists of PM10 samplers, Dichots, TEOMs and COH samplers.

Special studies were undertaken in the early 1990's to understand the nature of our PM10, and ultimately PM2.5, particulates. The results of the studies (Chow, J.C. et al, **Source Apportionment of Wintertime PM10 at San Jose, California,** Journal of Environmental Engineering, May 1995, pages 378 to 387) in the Santa Clara Valley indicated that wood smoke and diesel, and automobile exhaust were significant sources of PM10 particulates and that ammonium nitrate was also a significant fraction of the total. Wood smoke and nitrates are expected to be a larger fraction of the PM2.5 weight than of the PM10 weight.

3.2 Site Description

The BAAQMD will deploy eleven instruments at nine sites. Table 3.2.1 shows those sites along with their spatial scale, monitoring objective, type and measurement method. All sites will operate FRM monitors that will be purchased through EPA contracts. All sites will be core-SLAMS for the "Site-Type". Data from all sites can be compared to both the annual-average standard and the 24-hour- standard because each site meets the following criteria: (1) Population-oriented location; and (2) Representative of a neighborhood spatial scale. In addition, two sites are appropriate to use for transport assessment because of their distance from possible sources of PM2.5 and the collocated meteorological towers.

Table 1.4 in Section 1.4 of this plan shows the general activities that surround each PM2.5 site. While all sites are surrounded by medium to large populations and commercial development, Vallejo and Concord have added influences from petrochemical industries located in Contra Costa and Solano Counties. During winter months, San Francisco can be influenced from those industries when the airflow is easterly and the temperature inversion is strong. Each site also has proximity to one or more of the Bay Area's freeways that will influence PM2.5 concentrations. Thus the volume of traffic in all of the communities to be monitored will have some impact on PM2.5 at each of the sites.

Table 3.2.1 PM2.5 Monitoring Sites to be Deployed in 1998

Site Location	AIRS Site ID	Operating Agency	Spatial Scale	Monitoring Objective	Site Type	Measurement Method
Fremont - Chapel Way	06 001 1001	BA	Neighborhood	R	C	G-A Sequential
Livermore - Old First St.	06 001 0003	BA	Neighborhood	M,T	C	G-A Sequential
Concord - 2975 Treat Blvd.	06 013 0002	BA	Neighborhood	R	C	G-A Sequential
San Francisco - Arkansas St.	06 075 0005	BA	Neighborhood	M	C	G-A Sequential
Redwood City	06 081 1001	BA	Neighborhood	R	C	G-A Sequential
San Jose - 4th St.	06 085 0004	BA	Neighborhood	M	C	G-A Sequential
San Jose - Tully Rd.	06 085 2003	BA	Neighborhood	M	C	G-A Sequential
Vallejo - 304 Tuolumne	06 095 0004	BA	Neighborhood	M,T	C	G-A Sequential
Santa Rosa - 837-5th St.	06 097 0003	BA	Neighborhood	M	C	G-A Sequential

Codes:

Operating Agency:

BA - Bay Area AQMD

Monitoring Objectives:

R - To determine representative high concentrations in a populated area.
M - To determine the highest concentration expected to occur in the area covered by the network (more than one site per area may be needed).
T - To determine the extent of regional pollutant transport.
HS - To support special health studies.

Site Type:

C - Core SLAMS
S - Non-core SLAMS
P - Special Purpose Monitors

4.0 PM2.5 MONITORING SITES TO BE DEPLOYED IN 1999

At this time there are no additional sites planned to be deployed in 1999 in the BAAQMD. We expect to have the basic PM2.5 monitoring network in place by the end of 1998. We are planning to deploy PM2.5 chemical speciation monitors in 1999 at four locations.

4.1 Monitoring Sites Operating PM2.5 FRM Monitors

There are no additional sites planned to be deployed in 1999 in the BAAQMD.

4.2 PM2.5 Chemical Speciation

Four speciation samplers are to be deployed in 1999 as shown in Table 4.2.1. Two sites, San Jose Fourth Street and San Francisco Arkansas Street, were selected because they have been the long term locations that have been the most active particulate sites in the BAAQMD. The San Francisco station is in a commercial-industrial-residential community mix and surrounded by major downtown freeways. This station has experienced some high PM10 at times. The San Jose location is one of the longest operating PM2.5 Dichot and PM10 locations. It is in a commercial-residential setting with significant roadways and freeways nearby, and woodsmoke is expected to be a significant portion of its PM2.5 total.

Livermore was selected because it was one of the few stations to experience a 24-hour PM10 excess; it is in a growing area with rapidly increasing traffic, and it is in a major air transport corridor between the Bay Area and the Central Valley. As with PM10, it can be expected to see east to west transport as well as the reverse. Concord is in an area that has developed similar to San Jose with rapid growth in population, traffic and commercial businesses. There are also a number of petrochemical industries located nearby.

We expect the data to be used to better understand the nature of our PM2.5 problem, in source attribution analyses, in air quality modeling, and related studies. The data should also be useful for local and regional health studies.

Table 4.2.1 PM2.5 Chemical Speciation Monitoring

Site Location	AIRS Site ID	Operating Agency	Monitoring Method
San Francisco - Arkansas St.	06 075 0005	BA	**To be determined.**
San Jose - 4th St.	06 085 0004	BA	**To be determined.**
Livermore	06 001 0003	BA	**To be determined.**
Concord	06 013 0002	BA	**To be determined.**

4.3 Continuous PM2.5 Monitoring

The BAAQMD is expected to have 3 continuous PM2.5 monitors running by late 1999. One will be deployed in the Oakland PMSA, one in the San Francisco PMSA and the other in the San Jose PMSA.

5.0 SAMPLING FREQUENCY

The federal requirements call for everyday sampling for PM2.5 at certain core SLAMS and one in three day sampling at all other PM2.5 sites, and all PM10 sites. In order to collect sufficient data and at the same time conserve limited monitoring and laboratory resources, we are proposing alternative sampling frequencies for PM2.5 and PM10.

5.1 PM2.5 FRM Sampling Frequency

The BAAQMD proposes the sampling frequencies as shown in Table 5.1.1. In it we have listed a reasonable sampling schedule that we believe will meet EPA objectives to define the extent of PM2.5 problem, the area of concern, and to obtain complete and valid data sets.

Table 5.1.1 PM2.5 Sampling Frequency

Site Location	**AIRS Site ID**	**Sampling Frequency**		
		Required	Proposed Time period	Proposed Frequency
Fremont - Chapel Way	06 001 1001	1 in 3 days	a - b,c	Initially 1 then 2,1
Livermore - Old First St.	06 001 0003	Everyday	a - b,c	Initially 1 then 2,3
Concord - 2975 Treat Blvd.	06 013 0002	Everyday	a - b,c	Initially 1 then 2,3
San Francisco - Arkansas St.	06 075 0005	1 in 3 days	a - b,c	Initially 1 then 2,1
Redwood City	06 081 1001	1 in 3 days	a - b,c	Initially 1 then 2,1
San Jose - 4th St.	06 085 0004	Everyday	a - b,c	Initially 1 then 2,3
San Jose - Tully Rd.	06 085 2003	Everyday	a - b,c	Initially 1 then 2,3
Vallejo - 304 Tuolumne	06 095 0004	1 in 3 days	a - b,c	Initially 1 then 2,1
Santa Rosa - 897-5th St.	06 097 0003	1 in 3 days	a - b,c	Initially 1 then 2,1

Time Period	**Frequency**
a - 1998 to 3/31/1999	1 - 1 in 3 days
b - 4/1/1999 to 9/30/1999	2 - 1 in 6 days
c - 10/1/1999 to 3/31/2000	3 - everyday

The pattern of b and c will continue indefinitely with the appropriate date changes and frequency

Given the BAAQMD's history with a 1 in 6 days sampling schedule for its PM10 and current PM2.5 samplers (Dichot and/or Partisol), the more frequent monitoring desired by EPA appears to be too frequent. The BAAQMD has not had a 24-hour excess of the current national PM10 or PM2.5 standards since January of 1991 (Table 5.1.2). This PM2.5 experience is based upon data collected at our long-term Dichot station (San Jose Fourth Street). The Bay Area has not exceeded the National annual PM10 Standard, 50$\mu g/m^3$, since 1986 and all sites have been below 30 $\mu g/m^3$ since 1993. Additionally, the BAAQMD 1997 Dichot data from Concord and Livermore and Partisol data from San Jose Fourth Street station showed annual arithmetic averages below 15 $\mu g/m^3$ for PM2.5.

Table 5.1.2
San Jose Fourth Street Dichot Sampling for PM2.5

Year	24-hour highest value	Annual Arithmetic Average
1990	105	18.3
1991	86	16.7
1992	59	13.8
1993	60	12.9
1994	55	12.6
1995	36	10.3
1996	40	9.5
1997	44*	

*** Through May 1997**
Note: All values are in $\mu g/m^3$

The BAAQMD proposes a one in three days sampling schedule for all stations through March 1999. The justification is our need to obtain and train personnel and to make necessary equipment modifications created by the field and laboratory demands of the PM2.5 Program. Additionally, we propose that PM2.5 samplingbe reduced to 1 in 6 days for all locations during the expected low concentration months that coincide with our ozone season of April to September. Table 5.1.3 shows the 1990-1997 April through September history ofthe San Jose Fourth Street Dichot sampling (1997 through August). The table shows the three highest 24-hour fine PM2.5 concentrations. From the months of April to September, values are all less than 20 $\mu g/m^3$. In Table 5.1.4, the highest and second highest PM10 values for 1992-1997 April through September suggest that we can expect 24-hour concentrations well below the national standards.

Table 5.1.3 Highest Three PM2.5 Dichot 24-Hour Concentrations at San Jose Fourth Street by Year for April through September

Year	1st high $\mu g/m^3$	2nd high $\mu g/m^3$	3rd high $\mu g/m^3$
1990	15	14	13
1991	16	15	14
1992	16	14	14
1993	18	12	12
1994	16	13	12
1995	14	11	11
1996	14	13	13
1997*	13	12	10

*1997 Data through August

Table 5.1.4 PM 10 Highest and Second Highest 24-Hour Concentrations by Station and Year for April through September

STATION	1992 High 1^{st} / 2^{ND}	1993 High 1^{st} / 2^{ND}	1994 High 1^{st} / 2^{ND}	1995 High 1^{st} / 2^{ND}	1996 High 1^{st} / 2^{ND}	1997 High 1^{st} / 2^{ND}
SAN FRANCISCO	49 / 47	52 / 49	43 / 42	44 / 44	46 / 43	42 / 36
SAN RAFAEL	28 / 27	34 / 32	31 / 31	27 / 26	47 / 39	34 / 26
RICHMOND / SAN PABLO	42 / 40	47 / 46	38 / 37	39 / 37	43 / 36	37 / 34
NAPA	35 / 34	40 / 34	31 / 31	29 / 28	34 / 31	23 / 22
CONCORD	33 / 30	49 / 41	33 / 31	23 / 21	32 / 31	23 / 22
BETHEL ISLAND	55 / 34	52 / 45	37 / 36	40 / 37	41 / 35	39 / 28
SAN LEANDRO	46 / 39	47 / 35	38 / 34	42 / 35	39 / 39	30 / 26
FREMONT	45 / 39	58 / 37	40 / 39	37 / 35	38 / 38	44 / 43
LIVERMORE	62 / 46	44 / 32	40 / 36	37 / 36	38 / 35	43 / 42
SAN JOSE-4TH	60 / 56	53 / 48	39 / 38	38 / 38	36 / 36	37 / 36
SAN JOSE EAST (PIEDMONT)					39 / 38	39 / 32
SAN JOSE- MOORPARK	40 / 39	37 / 33	34 / 32	25 / 25	30 / 29	27 / 26
SAN JOSE-TULLY	52 / 40	50 / 35	37 / 34	40 / 32	31 / 29	34 / 28
SANTA ROSA				24 / 23	35 / 30	29 / 25
VALLEJO				25 / 25	30 / 28	23 / 23
REDWOOD CITY	42 / 35	35 / 35	35 / 31	32 / 30	34 / 33	37 / 34

5.2 Chemical Speciation Sampling Frequency

The required sampling frequency for PM2.5 chemical speciation of 1 in twelve days is acceptable to the BAAQMD. Should a need arise for more frequent sampling in the future, we will alter our schedule to accommodate the data requirements depending upon available resources.

5.3 PM10 Sampling Frequency

Although the new EPA minimum required sampling frequency for PM10 is 1 in 3 days, the BAAQMD proposes and 1 in 6 day schedule. The CARB has requested a waiver for the new requirement covering all of California from EPA-Region IX and the BAAQMD supports that request. Our PM10 history, as discussed above in several sections of this document, argues in support of the waiver.

APPENDIX A Sampling Site Descriptions

The HCIR documents previously prepared and accepted by EPA are included in this document for stations proposed for PM2.5 monitoring by the BAAQMD. The placement of the PM2.5 instruments will be close to the PM10 monitors.